International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

Analysis and Design of Multistoreyed Building With Grid Slab Using E-Tabs

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ABSTRACT

Grid floor systems consisting of beams spaced at regular intervals in perpendicular directions monolithic with slab. They are generally employed for architectural reasons for large rooms such as auditoriums, vestibules, theatre halls, show rooms of shops where column free space is often the main requirement. The rectangular or square void formed in the ceiling is advantageously utilized for concealed architectural lighting. The sizes of the beams running in perpendicular directions are generally kept the same. Instead of rectangular beam grid, a diagonal. In the present problem G+5 Building is consider and analysis and design is done for both Gravity and lateral (earth quake and wind) loads. And this is compared with the flat slab. Grid is highly redundant structural system and therefore statically indeterminate. Grid floor systems consisting of beams spaced at regular intervals in perpendicular directions, monolithic with slab. They are generally employed for architectural reasons for large rooms such as auditoriums, vestibules, theatre halls, show rooms of shops where column free space is often the main requirement. The rectangular or square void formed in the ceiling is advantageously utilized for concealed architectural lighting. The sizes of the beams running in perpendicular directions are generally kept the same. Instead of rectangular beam grid, a diagonal. In the present problem, G+5 building is considered and analysis and design is done for both Gravity and lateral (earthquake and wind) loads. And this is compared with the flat slab.

INTRODUCTION

A Multi-Stored building has multiple floors above the ground in the building. These type of buildings are mainly to increase the floor area of the building without increasing the area of the land where building is built, so it is saving land. The process of built multi-stored buildings are requires practical aspects knowledge, recent design codes, bye laws, intuition and judgment of the structures. To be knowledgeable about the planning and designing of such multistoried Buildings. Advancements of computer packages have given many tools to the designer towards achieving the best and accuracy in their work an attempt is made in this project to utilize the computer packages and comparing the results with manual procedures.

GRID SLAB Grid floor systems consisting of beams spaced at regular interval in perpendicular directions, monolithic with slab. Slabs spanning in one directin will be supported at two ends. Slabs supporting on all four sides: These are further classified into two types based on aspect ratio(ly/lx)
a) One way slabs: If (ly/lx)>2
b) Two way slabs: If (ly/lx)<2
If a solid slab supported on two opposite edges, carries concentrated loads, the maximum B.M developed by the concentrated loads shall be assumed to be resisted by an effective width of slab (measured parallel to the supporting edges).

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof,food, cloth and the basic needs of human beings. In the early ancient times humans lived incaves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as thetimes passed as humans being started living in huts made of timber branches. The shelters ofthose old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses. Buildings are the important indicator of social progress of the county. Every human hasdesire to own comfortable homes on an average generally one spends his two-third life times inthe houses. The security civic sense of the responsibility. These are the few reasons which areresponsible that the person do utmost effort and spend hard earned saving in

owning houses.Nowadays the house building is major work of the social progress of the county

Design of multi storied residential building:

Efforts of an engineer will be engaged to prepare the construction activities plans and respective specifications and supervise the construction of the project at the lowest practical cost. Engineer responsible to reduce cost without reducing service and quality for which construction equipment and machinery contributes a lot. A structure is an assemblage of individual elements like pinned elements (truss elements). Structural engineering is concerned with the planning, designing and the construction of structures. Design process involves the selection and detailing of the components that make up the structural system.The main object of reinforced concrete design is to achieve a structure that will result in a safe economical solution. The objective of the design is

1. Foundation design
2. Column design
3. Beam design
4. Slab design

LITERATURE SURVEY

TorbenValdbjorn Rasmussen (2013) has worked on Novel Radon Sub-Slab Suctioning System.. The function of this system is based on the principles of pressure reduction within the zone below the ground-floor construction. Unfortunately, earthquake experience has proved that this form of construction is vulnerable to failure, when not designed and detailed properly, in which the thin concrete slab fractures around the supporting columns and drops downward, leading potentially to a complete progressive collapse of a building as one floor cascade, this project is mostly based on software and it is essential to know the details about these software's.

STAAD

Staad is powerful design software licensed by Bentley. Staad stands for structural analysis and design.Any object which is stable under a given loading can be considered as structure. So first find the outline of the structure. To calculate S.F.D and B.M.D of a complex loading beam it takes about an hour. But it is easy for normal constructions but when it comes to complex buildings which contain complex members it will take much time, so a much sophisticated software called Staad pro is used which do this job in just an hour's time. Now a-days many high rise buildings are designed using staad software which makes the work easier. It can be used for RCC, steel, bridge, Truss etc according to various country codes.

Alternatives for staad:
Struts, robot, SAP adds pro which gives details very clearly regarding reinforcement and manual calculations. But these software's are restricted to some designs only whereas staad can deal with several types of structure.

AUTOCAD

AutoCAD is a software which is used for drawing layouts of different structures, details, plans, elevations, sections.. It is very useful software for civil, mechanical and also electrical engineer. Generally AutoCAD is used for drawing the plan, elevation and other views of a residential building. We also used AutoCAD to show the reinforcement details and design details of a stair case.

PLAN:

The auto cad of the fig below represents the plan of a g+6 building. The plan clearly shows that it is a combination of five apartments. One can observe that there is a combination between each and every apartment. In each block the entire floor consists of a three bed room house which occupies entire floor of a block. It represents a rich locality with huge areas for each house. It is a g+6 proposed building, So for 5 blocks we have 5*6=30 flats

INTRODUCTION TO E-TABS SOFTWARE:

E-TABS is quick and easy for simple structures and analysis and design it can also handle the largest and most complex models and it the tool of choice for

structural engineers in the various building industry. It has powerful graphical interface It's take many years to develop the software. It providing a tool that offered significant savings in time and increased accuracy over general purpose programs. E-TABS topographies an instinctive and influential graphical border coupled with supreme demonstrating, analytical, design, and detailing measures, all integrated by a collective record. Though quick and relaxed for humble structures.

LOADING

Load Conditions and Structural System Response :

The concepts which are explained in this section provides us an overview of building loads and effect of loads on the structural system. Generally building loads are divided into differet types based on the direction of the structural action or forces they produce i.e. vertical and horizontal (i.e., lateral) loads. Classification of loads are described in the following sections.

BUILDING DESCRIPTION

An framed building located at Hyderabad India (Seismic Zone -II) is selected for the present study. The building is fairly symmetric in plan and in elevation.

Ø No. of Floors of Building – G+6
Ø Slab Thickness – 150 m
Ø Each Floor Height – 3.0 m
Ø Total Height of the Building – 18 m
Ø External Wall Thick – 230 mm
Ø Internal Thickness – 120 mm
Ø For Live Load – 3.5 kN/m
Ø Column Sizes – 400 x 400 mm
Ø Beam Sizes – 300 x 450 mm

The cross sections of the structural members (columns 300 mm×600 mm and beams 300 x 450 mm) are equal in all frames and all stories. Storey masses to 295 and 237 tons in the bottom storeys and at the roof level, respectively. The design base shear was equal to 0.15 times the total weight.

BEAMS

A structural member subjected to transverse loads (loads perpendicular to; its longitudinal axis) is called as beam. A beam may be classified as:

Floor beam: A major beam of a floor system usually supporting joints in building. Girder: In buildings gilrders are the same as floor beams also a major beam in a structure. A beam supporting floor construction but not major beams.Cross sections in which the extreme fiber in compression can reach yield stress, but can't develop the plastic moment of resistance due to local buckling are called semi compact section

Beam design:

A reinforced concrete beam should be able to resist tensile, compressive and shear stress induced in it by loads on the beam.

There are three types of reinforced concrete beams
1.) Single reinforced beams
2.) Double reinforced concrete
3.) Flanged beams

COLUMNS

A column or strut is a compression member, which is used primary to support axial compressive loads and with a height of at least three it is least lateral dimension. Depending upon the architectural requirements and loads to be supported,R.C columns may be cast in various shapes i.e square ,rectangle, and hexagonal ,octagonal,circular.Columns of L shaped or T shaped are also sometimes used in multistoried buildings. The longitudinal bars in columns help to bear the load in the combination with the concrete.The longitudinal bars are held in position by transverse reinforcement, or lateral binders.The binders prevent displacement of longitudinal bars during concreting operation and also check the tendency of their buckling towards under loads.

Positioning of columns:

Some of the guiding principles which help the positioning of the columns are as follows:-

A) Columns should be preferably located at or near the corners of the building and at the intersection of the wall, but for the columns on the property line as the following requirements some area beyond the

column, the column can be shifted inside along a cross wall to provide the required area for the footing with in the property line. Alternatively a combined or a strap footing may be provided.

B) The spacing between the column is governed by the lamination on spans of supported beams, as the spanning of the column decides the span of the beam. As the span of the of the beam increases, the depth of the beam, and hence the self-weight of the beam and the total.

SLABS

Slab design:

Slab is plate elements forming floor and roofs of buildings carrying distributed loads primarily by flexure.

One way slab:
One way slab are those in which the length is more than twice the breadth it can be simply supported beam or continuous beam.

Two way slab:
When slabs are supported to four sides two ways spanning action occurs. Such as slab are simply supported on any or continuous or all sides the deflections and bending moments are considerably reduces as compared to those in one way slab.

Checks:
There is no need to check serviceability conditions, because design satisfying the span
for depth ratio.
a.) Simply supported slab
b.) Continuous beam

FOUNDATION

Foundations are structural elements that transfer loads from the building or individual column to the earth .If these loads are to be properly transmitted, foundations must be designed to prevent excessive settlement or rotation, to minimize differential settlement and to provide adequate safety against sliding and overturning.

GENERAL:

1) Footing shall be designed to sustain the applied loads, moments and forces and the induced reactions and to assure that any settlements which may occur will be as nearly uniform as possible and the safe bearing capacity of soil is not exceeded.

2) Thickness at the edge of the footing: in reinforced and plain concrete footing at the edge shall be not less than 150 mm for footing on the soil nor less than 300mm above the tops of the pile for footing on piles.

Bearing capacity of soil:

The size foundation depends on permissible bearing capacity of soil. The total load per unit area under the footing must be less than the permissible bearing capacity of soil to the excessive settlements.

CONCLUSION:

1. In this present work ETABS is used to analysis the R.C moment resting frame structure of
G+5 considering the gravity and lateral loads. The following conclusion is drawn from present
work. Maximum time period is 3.53901 for mode -1 in the structure.
2. For maximum time period the natural frequency is 0.28256 cycles/sec
3. Modal participating mass ratios for mode-10 is x-trans is 97% and Y-trans is 99%
4. Maximum axial force in the structure is 23031.36 kN
5. Maximum tensile force in the frame is 7350.726 kN.
6. Maximum diaphragm drift is 0.007700.
7. Design of R.C.C columna)Size 230 x 450 b)Reinforcement 8no's of 12dia c)0.874 %
reinforcement.
8. Design of R.C.C Beam. a)Size 230 x 380 b) 0.85 % reinforcement
9. Design of R.C.C slab a)200 mm thickness b)8 dia 230mm spacing
10. Design of R.C.C footing a)2.5m x 2.3m
11. Maximum displacement is observed in flat slab with drop compare to grid slab with and
without infills in both zones, but deflection is more in zone IV than zone III.

12.Maximum Time period of grid slab is less in compare with flat slab with and without drop with and without infills structures in zone IV. Structures without infills having significantly more time period compare to structure with infills.
13.Grid slab structures possess maximum base shear in comparison with flat slab with and without drop in both zones.
14. Storey drift values of different types of buildings are within the permissible limit as per IS-1893-2002 code provision i.e. 0.4% of the floor height.

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